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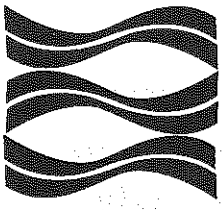

IRISH FISHERIES INVESTIGATIONS

E. Fahy and P. Gleeson

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Roinn na Mara

(Department of the Marine)

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The exploitation of angler fish *Lophius* Spp. in Irish waters

by

EDWARD FAHY AND PAUL GLEESON
Department of the Marine, Fisheries Research Centre,
Abbotstown, Dublin 15, Ireland.

ABSTRACT

Two species of European angler, *Lophius piscatorius* and *L. budegassa* occur in Irish waters. *L piscatorius* is dominant, particularly closer to the coast; *L. budegassa* becomes more important moving south and in landings from medium/deep water. Three stocks of anglers are recognized; this work concerns the fish in the central one, specifically in ICES Divisions VIIb, c and j,k.

Anglers are taken in a mixed demersal fishery, and they are particularly associated with hake and megrim. Most landings of the species come from ICES Divisions VIIg-k. The species have traditionally been taken in a mixed demersal fishery, mainly by France and Scotland. Ireland's landings have increased from 100t in 1977 to in excess of 2,000t in recent years.

Species composition of the landings was determined by port sampling. The proportion of *Lophius piscatorius*, while still dominant, has declined since the mid 1980s. A short CPUE time series from joint venture vessels fishing medium/deep water (approximately 200 m) shows no consistent trends although the values for 1991 were the lowest in the six years.

Irish vessels take anglers of slightly greater weight than do their joint venture (Spanish) counterparts. Length frequency distributions of both species from the Irish trawl fishery are available from 1987 to 1991 inclusive. They are redistributed by age using French ALKs. The age distribution shows no particular trend for *L budegassa* whereas that for *L. piscatorius* shows evidence of strong year classes from the mid 1980s passing through the population. The sharp reduction in angler CPUE in 1991 may have resulted from the exhaustion of strong mid 1980s year classes of *L piscatorius*. A large plus group in the age distribution of *L piscatorius* restricted interpretation of its population structure. Discarding of anglers appears to be very low in the south western Irish trawl fisheries, an estimate of 6.8% landed weight being used in this assessment.

A catch curve for *L piscatorius* suggested a value of Z+0.48; taking M=0.15 provides a value for F=0.33, to the right of F_{max} and in general agreement with what has been concluded for this species in recent assessments.

INTRODUCTION

Two species of European angler or monk fish *Lophius* occur in ICES Sub-areas VI and VII, *L piscatorius,* the white bellied and *L. budegassa,* the black bellied angler. Both are taken in a mixed demersal fishery although there has been an increasing tendency over the past five years to fish them by directed enmeshing gears. Anglers are species in which Ireland has developed an interest only in the recent past. They are species whose maximum value is fresh rather than processed and for which continental Europe has provided the main markets. The development of fisheries for anglers also has much in common with those for hake and megrim with which comparison is unavoidable. Three stock divisions of angler-fish are recognized, Sub-area VI, Divisions VIIb-k and VIIIa, b, and Divisions VIIIc and IXa. These should be regarded as administrative rather than true stock units; Crozier (1984) has shown that *Lophius piscatorius* in the Irish Sea comprises a separate breeding unit to the species off the west coast of Scotland.

Development of the fishery

Anglers are usually landed gutted, although they may be landed as tails only. In the latter case a conversion factor of 2 is used to establish the landed weight; gutted weights are not adjusted.

In common with the fishery for hake and megrim, the landings of anglers from the ICES Divisions surrounding Ireland peaked in the mid-1970s; unlike the other species they rose again in the mid-1980s (Fig 1, source *Bulletin Statistique*). Anglers appear to have been less comprehensively documented than either hake or megrim, the landings from these Divisions are attributable to nation since 1968 and it is possible to provide a breakdown of the provenance of Ireland's anglers only since 1977. Before that year Ireland's recorded landings of these species were negligible and this is a feature common to hake and megrim (Fahy and Gleeson, in press a; Fahy and Fannon, 1991).

Most angler landings from the Divisions adjoining Ireland come from VIIg-k, Division VIa coming second (Fig 2). The Irish Sea (VIIa) contributes little to the overall yield.

For comparison with the work on hake and megrim, the same format of presenting the landings data is used. France and the U.K. (Scotland) are the principal catching nations, Spain being prominent in the mid-1970s coincident with the heaviest landings of the period 1960-1987.

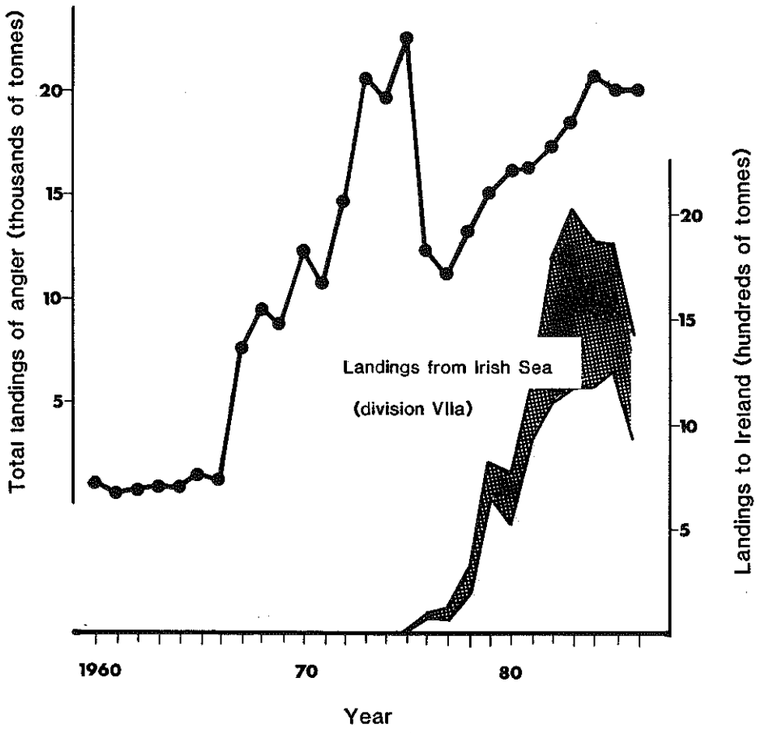

Fig. 1. Landings of anglers from ICES Divisions adjoining Ireland, 1961-1986 inclusive and the landings of these species to Ireland. Ireland's landings from the Irish Sea, Division VIIa, are shown by shaded area.

Although the Irish Sea produces a small percentage of total angler, it is an important source of landings to Ireland. In 1985 42% of Irish landings came from Division VIIa; in 1977 only anglers from this Division were recorded in the landings and in the intervening years fractions of between 1/5 and 1/3 total landings to Ireland from this Division were common (Fig 2). For comparison with data on megrim and hake, Division VIIa is excluded from the percentage distribution of landings by ICES Division. As in the case of megrim and hake, Divisions VIIg-k are the most important source of anglers.

MATERIALS AND METHODS

Length frequency data on the landings of angler were collected from Irish vessels at Rossaveal, Castletownbere and Unionhall throughout the year with coverage of landings to Burtonport and Dingle during the summer months (Quarter 3) of recent years. Joint venture (Spanish) vessels landing into Castletowbere were sampled less frequently.

Discards from the Irish trawl fleet were examined at Castletownbere and at Unionhall; in the case of the former the vessels targeted whitefish and, in the case of the latter, whitefish and *Nephrops*.

Logsheets from the Spanish joint venture fleet were analyzed from the introduction of the European Communities Logbook in the second quarter of 1985. In all, 121,500 hours of trawling provide the basis for a short time series of CPUE.

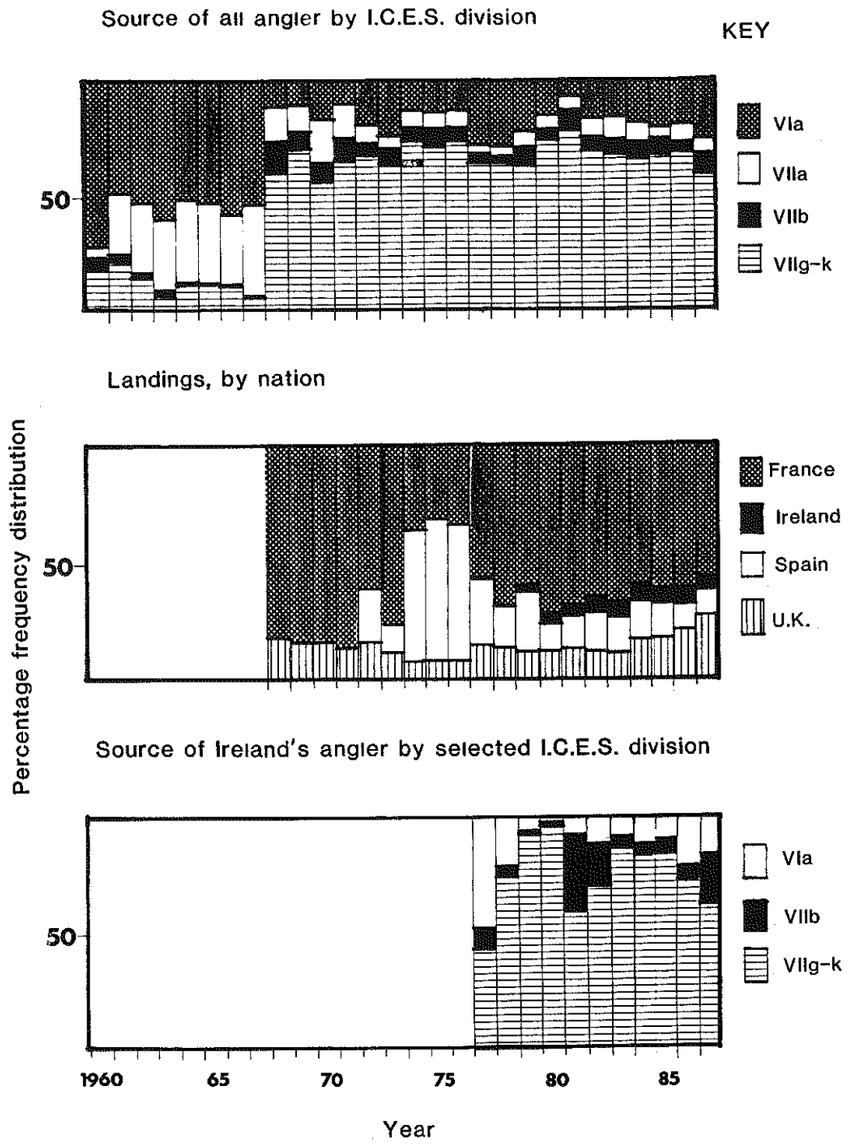

Fig. 2. Selected details of angler landings from ICES Divisions adjoining Ireland, 1961-1986.

RESULTS

Species composition

Occasionally black bellied and white bellied angler are separated for marketing but this is generally not the case and the relative contribution of each to the total is deduced from sampling. The relevant ICES working groups (Anon 1990, 1991a, b) contain details of the sampled proportions in the landings of the various nations participating in the assessments (Table 1). *L. piscatorius* predominates in sub-area VII although its relative contribution to the landings fluctuated between 65 and 85% between 1984 and 1990.

Some generalizations about the relative proportions of the species in waters adjoining Ireland are also possible: in Sub-area VI *L. piscatorius* contributes more to the landings than in the Sub-area further south and *L. budegassa* can be more important in the landings of the joint venture (Spanish) vessels which trawl in the vicinity of the 200 m depth contour (Table 2) (Fahy and Gleeson, in press b) although information on Spanish landings is based on fewer and smaller samples and is, hence, less reliable. Angler taken by the Irish, more inshore fishing fleet, has contained progressively less *L. piscatorius* in Sub-areas VI and VII since sampling commenced. This species characterises shallower waters - Crozier (1984) reports it as the only species in the Irish Sea (Division VIIa) - so the declining incidence of *L. piscatorius* in the catches might reflect a change in fishing grounds, the fleet moving further offshore, or a real alteration in the relative abundance of the species.

Recent history of the fishery

Data provided in the format of the Communities' Logbook from the joint venture vessels make up a short time series from the second quarter of 1985 to the end of 1991 (Table 3). In contrast to the position of hake and megrim whose CPUE has declined, that of angler has shown no consistent trends although 1991 provided the lowest values in the series. Although there are differences between the relative contribution of the species to the catches of the joint venture and Irish inshore demersal fleets, the record of the joint venture boats is not so consistent and is not based on so much material. Integrating the proportions of the two species from the Irish inshore fleet with these CPUE figures, provides indications that *L. budegassa* has increased in abundance over the period whereas *L. piscatorius* has declined (Table 3) although these facts must be interpreted in the context of possible fleet movements.

Landings

Seasonal characteristics of angler samples are presented in Table 4 for the year 1991. *L. budegassa* is the smaller of the two and landings of both species in the second quarter are of slightly heavier average weight.

The length frequencies per 1,000 t of the two species in landings from Irish and joint venture vessels are set out in Table 5. Both fleets exploit a similar size range although the Spanish vessels take both species at lower average weight than their Irish, more inshore, counterparts. Annual length frequencies (at 5 cm intervals) of the two angler species are set out in Tables 6 and 7. Numbers are given in thousands per 1,000 tonnes between 1987 and 1991 and as percentage length frequency distributions.

The weight at length relationships established in these investigations in 1991 and used in the calculations here were:

	Slope	Intercept
L. piscatorius (gutted)	2.91	-4.16
L. budegassa (gutted)	2.91	-4.13
both species (round)	2.92	-4.10

Ageing

Until recently, stock assessments of *Lophius* were based on length rather than age frequencies but several studies on ageing are now available (Crozier, 1989; Dupouy et al, 1984) in addition to the estimates provided by the various ICES working groups on these species. Two such keys were used by the ICES working group on fishery units in Sub-areas VII and VIII in 1990 (Anon, 1991a), the length at age being based on readings of the illicium. These ALKs (Table 8) were used to distribute the length frequencies of Irish trawl-caught *Lophius* among age groups. The outcome of this exercise is contained in Table 9.

The ALKs used in this exercise cover only the smaller size groups and there are large plus groups, particularly of *L. budegassa,* where the 11+ group makes up almost one in four of the landings. There is no clear pattern of exploitation in this species, recruitment increasing from 2-6 years and older age groups making up the bulk of the catches (Table 9).

The length range of *L. piscatorius* is better covered by the ALK for that species; the 10+ group is also much smaller than its equivalent in the other species. The length/age frequencies of *L. piscatorius* display evidence of recognizable year classes passing through the population. Year classes of 1984 and 1985 appear to have been strong, the following year also having witnessed a good recruitment. By 1991 however, dominance of the length frequency distribution by a strong year class is not so obvious. (Catch at age of *L. piscatorius* in Divisions VII and VIII, reported in Anon 1990, display similar trends between 1987 and 1989).

Discards

Anglers are not selected using conventional mesh sizes but, contrasting with hake and, to a lesser extent, megrim, angler is not discarded to any great extent in the trawl fisheries for whitefish and *Nephrops* in southwest Ireland. The calculation of discards was undertaken along the same lines as for the other associated species: *Lophius* were segregated from other rejected material and their weight calculated as a percentage of the total landings (fish and crustacea) with which the samples were taken. Next, the percentage angler in the total landings was calculated (from Co-operative sales data). Finally, the discarded percentage of total landings was expressed as a proportion of the landed angler in the total landings (Table 10). In all, there were 17 samples in 1991; in these angler has average quarterly values of between 0 and 18%. Where anglers occurred, the two species were represented in a ratio of 1:1.Averaging the values given in Table 10 (disregarding the sample in which angler did not occur), a mean value of 6.8% discarded to landed was obtained. This was divided equally between the two species and their discard samples raised to this fraction of the landed weight.

Survival; yield per recruit

The addition of raised discard levels to the landings of both angler species is set out in Table 11. These figures are then re-grouped by age (Table 12).

A catch curve was calculated for *L. piscatorius,* ages 3-9 inclusive from which a value for Z of -0.48 was calculated (r=-0.9792). A value of M = 0.15 has been generally adopted in working group calculations for anglers, leaving an F value of 0.33.

A yield per recruit curve for this species was calculated using the following values (the growth parameters are contained in Anon, 1990 and they refer to the species in the Sub-area VI):

$M = 0.15$
$W_{\infty} = 18.459$kg (gutted)
$k = 0.1515$
$t_0 = -.7948$
$t_c = 1$
$t_r = 3$

The yield per recruit curve(Fig 3) puts F_{max} at F=0.2, so that a value of 0.33 is well to the right, on the descending arm of the curve.

DISCUSSION

The exploitation of *Lophius* species differs from that of megrim and hake in the relatively low known discard fraction in the catches; it is however important to stress that larger discard mortalities might occur in certain places (Anon 1991b) or by certain gears not sampled in the course of this work. Anon (1991a) recognizes that variation in discarding practices for these species exists; it should however be re-stated that high values for discards were selected from the range of data available in these investigations.

In contrast to the CPUE indices of megrim and hake, the medium/deep water trawl CPUE index for angler has not moved in a consistent direction. A problem acknowledged by Anon (1991b) was the species composition of the landings of angler, which is known only where sampling has taken place. Because certain trends in the species composition of the landings appeared evident in this case, the presence of *L. piscatorius* in the inshore samples was used to interpret CPUE indices for the landings made by the medium/deep water fleet. These data should be interpreted with caution. Changes in the population of *L. piscatorius* might be explained by the dominance of the landings by several strong year classes from the mid-1980s. The presence of strong year classes might well bias the estimate of Z (total mortality) calculated from the catch curve. *L. budegassa,* from the data presented here, would appear to have increased in abundance over the period of the short time series but, because of the ALK used to convert length frequencies to age which resulted in a plus group of more than 20%, less interpretation of population structure was feasible.

Consideration was given to the age of recruitment of *L. piscatorius,* the species for which most interpretation was attempted. Data in Table 12 suggest that recruitment could be regarded as complete as early as age 1, taking discards into account. However, Anon (1991 a) advises:

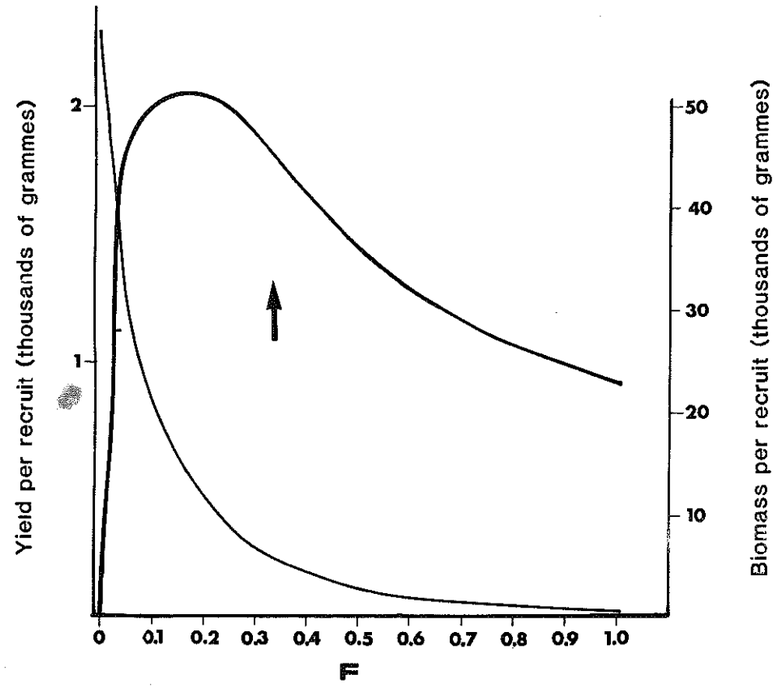

Fig. 3. Yield per recruit curve for *L. piscatorius*, current level of fishing mortality (F) in 1991 indicated (arrow).

"When estimating F_{max} from the yield per recruit analysis, care should be taken to consider only the landings instead of the total catches. . . "

Reference to Table 9 indicates that recruitment to the trawl fishery by *L. piscatorius* is complete at age 3.

In general characteristics, both *Lophius* species in the Irish catches from VIIb,j,g conform to what has been stated of them (Anon, 1991 b): fishing mortality rates are highest on fish in the length range 50-70 cm but very low on small fish.

The choice of growth parameters used in the calculation of the yield per recruit curve was determined by the availability of a complete set in the source used. Anon (1991b) employed several and found that the assessment of yield per recruit of angler in Division VIa was in fact insensitive to the choice of input growth parameters.

The yield per recruit curve for *L. piscatorius* in Sub-areas VII and VIII (Anon, 1991b) showed F_{max} to be in the vicinity of F=0.2 (Fig 3). Attaining this would require a reduction in effort of approximately 50%, a figure which is close to the 35% calculated in the assessment based on the samples from 1991. Such a reduction in effort would improve yield by some 17%; Anon (1991b) provided a figure of about 13%. In keeping with what has been said of the species elsewhere (Anon, 1991b) there would appear to be less reliable data on which to base an assessment of *L. budegassa*.

Anon (1990) concluded that the status of the two species of angler in Divisions VIIb-k and VIIIa,b was quite different. *L. budegassa* appeared to be in quite a good situation with the then current level of F at about F_{max}. *L. piscatorius* appeared to have an F level to the right of F_{max}, requiring a 40-60% reduction in effort to reach F_{max} which would lead to an increase in yield of about 15%. The assessments presented here, as far as they go, support these conclusions for *L. piscatorius* while the apparent increase in the abundance of *L budegassa,* from the interpretation of the CPUE data contained in this work, suggests that its population is not under such heavy pressure. The apparent reduction in angler CPUE, may result from the exhaustion of strong year classes of *L. piscatorius.*

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Fahy, E and P Gleeson (in press b) A second assessment of the stock of megrim *Lepidorhombus whiffiagonis* in Divisions VIIb,c,j and k, with particular reference to the landings of joint venture vessels.

TABLE 1. Quantities (tonnes x 1,000) of angler species landed in Sub-area VII (Source: ICES working group reports).

Year	*L. piscatorius*	*L. budegassa*	*L. piscatorius* as % of total
1984	12	2	85
1985	18	5	79
1986	17	8	68
1987	15	6	72
1988	14	3	65
1989	15	7	65
1990	15	6	69

TABLE 2. Percentage of *Lophius piscatorius* in sampled landings to Ireland, 1986—1991.

Year	Sub-area VII Joint venture fleet	Sub-area VII Irish fleet	Sub-area VI Irish fleet
1986	46	83	
1987	50	78	
1988		65	
1989	72	68	85
1990		62	81
1991	49	54	72

TABLE 3. Catch per unit effort (kg/hr) of *L. piscatorius* and *L. budegassa* by the joint venture (Spanish) trawl fleet.

Year	Quarter	TRAWL CPUE quarterly	CPUE annual	Percentage *L. piscatorius* (from samples of Irish trawl fleet)	CPUE *L. piscatorius*	CPUE *L. budegassa*
1985	1					
	2	42.33				
	3	14.94				
	4	14.40	18.88			
1986	1	16.63				
	2	16.04				
	3	20.60				
	4	17.86	17.59	83	14.60	2.99
1987	1	12.56				
	2	12.22				
	3	10.27				
	4	10.31	11.3	78	8.81	2.49
1988	1	12.83				
	2	16.04				
	3	13.49				
	4	12.10	14.51	65	9.43	5.08
1989	1	10.72				
	2	16.61				
	3	19.82				
	4	18.60	17.3	68	11.76	5.54
1990	1	15.63				
	2	19.73				
	3	15.03				
	4	24.96	18.32	62	11.36	6.96
1991	1	6.92				
	2	20.87				
	3	12.49				
	4	13.01	13.03	54	7.04	6.01

TABLE 4. Details of the sampled landings of angler species from Sub-Divisions VI and VII, by Irish and joint venture vessels in 1991.

	Qtr1	Qtr2	Qtr3	Qtr4	Totals
Irish vessels, mainly VIIj					
L. budegassa					
Numbers sampled	497	428	728	961	2614
Nos/tonne	583.80	540.30	688.30	843.30	
Ave wt (kg)	1.71	1.85	1.45	1.19	1.47
Sampled wt (kg)	851.32	792.15	1057.68	1139.57	3840.72
L. piscatorius					
Numbers sampled	354	332	562	806	2054
Nos/tonne	393.80	358.10	377.50	688.80	
Ave wt (kg)	2.54	2.79	2.65	1.45	2.18
Samplied wt (kg)	898.93	927.12	1488.74	1170.15	4484.94
%L. piscatorius	51.36	53.93	58.46	50.66	53.87
Spanish trawl, VIIj					
L. budegassa					
Numbers sampled	330	476	9	154	969
Nos/tonne	1065.5	931.30	600.1	1024.8	
Ave wt (kg)	.94	1.07	1.67	.98	1.02
Sampled wt (kg)	309.71	511.11	15.00	150.27	986.10
L. piscatorius					
Numbers sampled	250	111	8	105	474
Nos/tonne	541.40	479.10	418.10	487.00	
Ave wt (kg)	1.85	2.09	2.39	2.05	1.96
Sampled wt (kg)	461.77	231.68	19.13	215.61	928.19
% L. piscatorius	59.85	31.19	56.06	58.93	48.49
Irish trawl, VIa					
L. budegassa					
Numbers sampled					239
Nos/tonne					615.90
Ave wt (kg)					1.62
Sampled wt (kg)					388.05
L. piscatorius					
Numbers sampled					655
Nos/tonne					663.70
Ave wt (kg)					1.51
Sampled wt (kg)					986.89
% L. piscatorius					71.78

TABLE 5. Length frequency distributions of angler species landed by the Irish and joint venture fleets in 1991. Weights are standardised at 1,000 t; numbers are in thousands.

Minimum length cm	*L. piscatorius*		*L. budegassa*	
	Irish fleet	Spanish fleet	Irish fleet	Spanish fleet
10				
15		1.08		7.09
20	11.32	11.84	8.02	82.06
25	15.76	21.53	54.74	127.65
30	40.40	34.45	81.55	105.37
35	52.38	58.14	102.57	139.81
40	38.62	50.60	95.66	141.84
45	40.39	62.44	85.98	142.85
50	46.61	59.21	77.13	92.20
55	53.05	72.13	62.20	70.92
60	48.83	39.83	56.12	35.46
65	40.84	43.06	43.40	28.37
70	25.08	25.84	16.86	7.09
75	14.65	14.00	7.46	1.01
80	12.65	3.23	3.32	
85	4.88	3.23	1.11	
90	3.11	5.38	.28	
95	3.55			
100	2.22	2.15	.28	
105	.44	2.15	.28	
110	.22			
115	.44			
120	.22			
125				
130	.22			
Average weight (kg)	2.19	1.96	1.43	1.02

TABLE 6. Length frequency distributions of *L. piscatorius* in the sampled landings by Irish trawl, 1987-1991 inclusive (above) standardized at 1000 t landed weight and (below) percentage length frequencies.

Minimum length, cm	*Numbers in thousands*					
	1987	1988	1989	1990	1991	Average
10				.31		.06
15	.28					.06
20	34.53	5.46	4.54	3.41	11.32	11.85
25	168.09	37.48	36.30	16.74	15.76	55.07
30	142.40	93.51	54.45	16.73	40.40	69.50
35	117.07	87.35	64.43	33.12	52.38	70.87
40	79.13	70.41	96.19	42.73	38.62	65.42
45	66.27	67.49	92.56	41.80	40.39	61.70
50	39.23	55.89	89.84	61.02	46.61	58.52
55	33.00	43.74	46.28	67.21	53.05	48.66
60	23.87	37.82	36.30	63.17	48.83	42.00
65	20.45	27.20	22.69	43.04	40.84	30.84
70	14.49	17.23	19.06	21.67	25.08	19.51
75	13.62	13.08	12.70	13.64	14.65	13.54
80	11.08	10.77	5.44	8.37	12.65	9.66
85	7.11	15.70	2.72	4.03	4.88	6.89
90	4.81	3.61	3.63	3.41	3.11	3.71
95	5.09	5.31	2.72	1.86	3.55	3.71
100	1.11	1.31	3.63	1.55	2.22	1.96
105	1.15	.38		.62	.44	.52
110	1.29	.31		1.24	.22	.61
115	.42			.62	.44	.30
120		.62			.22	.17
125						
130	.28	.31			.22	.16
Totals	786	595	593	446	456	575
Mean wt, kg	1.27	1.68	1.69	2.24	2.19	

Percentage frequency distribution

10				.07		.01
15	.04					.01
20	4.39	.92	.77	.76	2.48	1.86
25	21.51	6.30	6.12	3.75	3.46	8.23
30	18.21	15.72	9.18	3.75	8.86	11.13
35	14.89	14.68	10.86	7.43	11.49	11.87
40	10.07	11.83	16.22	9.58	8.47	11.23
45	8.43	11.34	15.61	9.37	8.86	10.72
50	4.99	9.39	15.15	13.68	10.22	10.69
55	4.20	7.35	7.80	15.07	11.63	9.21
60	3.04	6.36	6.12	14.16	10.71	8.08
65	2.60	4.57	3.83	9.65	8.96	5.92
70	1.84	2.90	3.21	4.86	5.50	3.66
75	1.73	2.20	2.14	3.06	3.21	2.47
80	1.41	1.81	.92	1.88	2.77	1.76
85	.90	2.64	.46	.90	1.07	1.20
90	.61	.61	.61	.76	.68	.66
95	.65	.89	.46	.42	.78	.64
100	.14	.22	.61	.35	.49	.36
105	.15	.06		.14	.10	.09
110	.16	.05		.28	.05	.11
115	.05			.14	.10	.06
120		.10			.05	.03
125						
130	.04	.05			.05	.03

TABLE 7. Length frequency distributions of *L. budegassa* in the sampled landings of Irish trawl, 1987-1991 inclusive (above) standardized at 1000t landed weight and (below) percentage length frequencies.

Numbers in thousands

Minimum length, cm	1987	1988	1989	1990	1991	Average
20	10.00	.28			8.02	3.66
25	70.57	15.09	5.77	11.72	54.74	31.58
30	122.36	51.13	42.31	51.45	81.55	69.76
35	140.00	57.10	44.23	70.87	102.57	82.95
40	180.09	76.32	73.08	91.63	95.66	103.36
45	114.15	64.64	94.23	83.52	85.98	88.50
50	75.94	68.77	105.77	76.75	77.13	80.87
55	52.92	53.10	73.08	81.70	62.20	64.60
60	41.42	37.88	53.85	64.11	56.12	50.67
65	20.00	21.93	38.46	29.34	43.40	30.63
70	8.77	28.04	30.77	17.61	16.86	20.41
75	4.15	32.89		8.57	7.46	10.62
80	.94	2.56		4.06	3.32	2.18
85	.75	.56		1.80	1.11	.84
90					.28	.06
95				1.35		.27
100					.28	.06
105					.28	.06
Totals (rounded)	842	510	562	594	697	641
Ave wt, kg	1.19	1.96	1.78	1.68	1.43	

Percentage frequency distribution

20	1.19	.05			1.15	.48
25	8.38	2.96	1.03	1.97	7.85	4.44
30	14.53	10.03	7.53	8.66	11.70	10.49
35	16.63	11.20	7.87	11.93	14.72	12.47
40	21.39	14.96	13.00	15.43	13.72	15.70
45	13.56	12.67	16.77	14.06	12.34	13.88
50	9.02	13.48	18.82	12.92	11.07	13.06
55	6.29	10.41	13.00	13.75	8.92	10.48
60	4.92	7.43	9.58	10.79	8.05	8.15
65	2.38	4.30	6.84	4.94	6.23	4.94
70	1.04	5.50	5.47	2.96	2.42	3.48
75	.49	6.45		1.44	1.07	1.89
80	.11	.50		.68	.48	.35
85	.09	.11		.30	.16	.13
90					.04	.01
95				.23		.05
100					.04	.01
105					.04	.01

TABLE 8. ALKs for Lophius piscatorius and L. budegassa, from a French key based on interpretations of the illicium.

Age groups

Minimum length, cm	0	1	2	3	4	5	6	7	8	9	10	11	Totals
Lophius budegassa													
5	5	1											6
10		15	2										17
15		10	19	4									33
20			12	18	2								32
25				13	38	7							58
30					12	33	15						60
35						13	22	28	4				67
40							10	24	25	5			64
45								9	26	26	11		72
50									4	26	20	9	59
55										5	16	20	51
60											7	27	34
65												8	8
													561

Age groups

Minimum length, cm	0	1	2	3	4	5	6	7	8	9	10	11	Totals
L. piscatorius													
5	4												4
10	6	5											11
15	1	19	4										24
20		16	71	12									99
25		4	63	28	1								96
30			29	34	2								65
35			14	45	16	1							76
40			1	40	44	2							87
45				9	42	21							72
50					21	38	7						66
55					9	40	17						66
60						22	34	6					62
65						2	37	21	3				63
70							17	39	7				63
75								29	24	8			61
80								14	28	20	3		65
85								1	18	24	11		54
90									5	15	26		46
95										7	19		26
100											2		2
													1104

TABLE 9. Percentage age composition of Lophius species 1987-1991 in Irish trawl landings from sub-area VII.

Age group	1987	1988	1989	1990	1991	Average
L. piscatorius						
1	1.64	.41	.38	.35	.55	.67
2	28.23	14.65	10.84	6.16	10.22	14.02
3	30.80	25.72	22.50	13.12	17.75	21.98
4	16.09	20.23	25.81	18.44	17.02	19.52
5	9.47	16.04	20.80	25.39	19.95	18.33
6	5.30	9.84	10.08	20.08	16.70	12.40
7	3.44	5.42	5.08	9.47	9.57	6.60
8	1.98	3.13	2.00	3.4	3.92	2.89
9	1.44	2.46	1.09	1.74	2.18	1.78
10+	1.61	2.10	1.43	1.92	2.14	1.84
L. budegassa						
2	.45	.02			.43	.18
3	2.55	.69	.23	.44	2.41	1.26
4	8.47	3.95	2.18	3.02	7.56	5.04
5	12.23	8.04	5.80	7.31	10.24	8.72
6	12.43	8.52	6.50	8.49	9.90	9.17
7	16.66	11.87	10.27	12.52	12.84	12.83
8	14.85	12.00	12.89	12.69	11.45	12.78
9	11.16	12.70	16.66	13.32	11.28	13.02
10	9.35	13.34	17.56	15.75	11.84	13.57
11 +	11.86	28.88	27.91	26.47	22.06	23.44

TABLE 10. The estimation of angler discards at two Co-operatives in 1991. Co-op A: vessels target *Nephrops* and whitefish; Co-op B vessels target whitefish.

Location		Qtr 1	Qtr 2	Qtr 3	Qtr 4
Anglers as a percentage of total landings					
Co-op A		7	10	9	9
Co-op B		12	18	26	6
Angler discards as a percentage of total discards (from samples)					
Co-op A	Mean	0.31	0.14	0.11	1.63
	Range	0-0.5		0-0.54	1.23-1.87
	Samples	2	1	5	3
Co-op B	Mean		1.80	0	
	Range		0-5.49		
	Samples		5	1	
Ratio of angler discarded to angler landed					
Co-op A		0.04	0.01	0.01	0.18
Co-op B			0.10		

TABLE 11. The survival of *Lophius piscatorius* and *L. budegassa* from data obtained from the Irish trawl fishery

Lophius piscatorius				*Lophius budegassa*		
Minimum length, cm	Landings thousands per 1000 t	Discards	Totals	Landings thousands per 1000 t	Discards	Totals
5					93.79	93.79
10	.06	121.00	121.06		375.16	375.16
15	.06	48.40	48.46		93.79	93.79
20	11.85	24.20	36.05	3.66	93.79	97.45
25	55.07	48.40	103.47	31.58		31.58
30	69.50	24.20	93.70	69.76		69.76
35	70.87		70.87	82.95		82.95
40	65.42		65.42	103.36		103.36
45	61.70		61.70	88.50		88.50
50	58.52		58.52	80.87		80.87
55	48.66		48.66	64.60		64.60
60	42.00		42.00	50.67		50.67
65	30.84		30.84	30.63		30.63
70	19.51		19.51	20.41		20.41
75	13.54		13.54	10.62		10.62
80	9.66		9.66	2.18		2.18
85	6.89		6.89	.84		.84
90	3.71		3.71	.06		.06
95	3.71		3.71	.27		.27
100	1.96		1.96	.06		.06
105	.52		.52	.06		.06
110	.61		.61			
115	.30		.30			
120	.71		.71			
125						
130	.16		.16			

TABLE 12. Percentage age frequency distribution of two angler species in the catches of the inshore Irish trawl fleet in 1991.

Age group	*L. piscatorius*	*L. budegassa*
0		6.03
1	23.78	28.90
2	21.91	10.38
3	22.68	5.65
4	15.72	3.14
5	13.82	4.49
6	9.02	4.69
7	4.85	6.51
8	2.20	6.38
9	1.39	6.32
10	1.44 (plus group)	6.49
11		11.02 (plus group)

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